LAKE STATES ASPEN REPORT NO. 13

# ASPEN FOR VENEER

BY
HEREFORD GARLAND, DIRECTOR
FOREST PRODUCTS RESEARCH DIVISION
MICHIGAN COLLEGE OF MINING AND TECHNOLOGY



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## FOREWORD

During and since World War II, there has been increasing interest in aspen (Populus tremuloides) in the Lake States, its availability and supply, properties and uses, and management. Aspen is a tree of primary importance in 20 million acres or 40 percent of the total forest area of the three Lake States - Michigan, Minnesota, and Wisconsin.

At an informal meeting at Madison, Wisconsin, in January, 1947, forestry representatives of several federal, state, and industrial groups in the Lake States agreed that it would be desirable to bring up to date what is known on aspen and make it available to anyone interested. The job of preparing this information in the form of reports was assigned to each of the groups listed below. The reports will be duplicated as rapidly as completed, and the entire project should be finished by the end of 1947. Each report will concern one aspect of the subject. Copies will be available from the Lake States Forest Experiment Station or from each contributor.

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### Contributors to Lake States Aspen Reports

Lake States Forest Experiment Station, St. Paul 1, Minn.
Forest Products Laboratory, Madison 5, Wis.
North Central Region, U. S. Forest Service, Milwaukee 3, Wis.
Div. of Forestry, Univ. of Minnesota, University Farm, St. Paul 1, Minn.
School of Forestry and Conservation, University of Michigan, Ann Arbor, Mich.
Department of Forestry, Michigan State College, East Lansing, Mich.
Michigan College of Mining and Technology, Houghton, Mich.
Superior Wood Products, Inc., Duluth 2, Minn.
Forestry Agent, Chicago & North Western Railway System, St. Paul 1, Minn.

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By
Hereford Garland, Director
Forest Products Research Division
Michigan College of Mining and Technology

### INTRODUCTION

In considering possible uses for the large supply of aspen in the Lake States, veneer and plywood manufacture should not be overlooked. Although aspen is not currently in great demand as a veneer species, the reason is not because of technical deficiencies of the wood for this purpose, but rather because there is no appreciable veneer industry in the region adapted for using aspen as small logs, the form in which it is most available.

The technical properties of aspen make it especially well suited for many veneer products. These properties are quite similar to those of basswood and cottonwood, both of which are in demand in log sizes suited to conventional veneer equipment. Such equipment in the Lake States consists of rotary veneer lathes on which it is not economical to handle logs less than about 12 inches in diameter. The minimum diameter for most aspen logs would be about 8 inches.

The technical problems of producing and using veneer from small logs are not difficult to overcome and, in fact, have been worked out in practice. Because of the ease with which it can be cut, its excellent properties as a veneer wood, and its availability, the possibilities for increased veneering of aspen in this region appear excellent.

### PROPERTIES OF ASPEN AFFECTING VENEER USE

One of the most important properties of aspen from the standpoint of its use for veneer and plywood is its uniformity of structure. Aspen is technically classed as a diffuse porous hardwood. This means that the grain is generally not distinct. The annual rings do not form bands of hard and soft tissue as found in ring porous hardwoods like oak and in coniferous woods like yellow pine and Douglas fir. Uniformity of wood structure is important in making thin veneer sheets, as it controls uniformity of physical properties. This is particularly true in rotary cut veneer, where the cutting more or less parallels the annual rings. In woods with pronounced ring structure, thin sheets of veneer show variations in density as the knife passes from summer wood (dense zone of the annual ring) to spring wood (less dense part of the annual ring). This variation in density in the sheet of veneer produces variations in strength and shrinkage which detract from the structural value and stability of both veneer and plywood. Lack of uniform shrinkage causes distortion of veneer and plywood sheets with changes in atmospheric humidity and wood moisture content. Aspen has uniform wood structure common to such valued veneer woods as birch, maple, basswood, walnut, and mahogany.

Aspen is a wood of low density. This is an advantage in core veneer for plywood panels. Since the bending strength of a plywood panel depends primarily upon the strength of the surface plies, the core plies, for most uses, need not be as dense and strong as the surface plies. Where light weight is important in plywood, extremely low density materials (sandwich construction) are suitable for cores. In thin plywood panels, cores of comparatively low density and strength are advantageous in maintaining stability. Due to changes in humidity, plywood made of cross-banded structure develops internal shrinkage stresses which may distort the panel. A low density core tends to minimize these stresses. Basswood has long been valued as a core veneer, and aspen has similar properties, with the added advantage of superiority in shrinkage characteristics.

Low density gives aspen an advantage in use as shipping container veneer and plywood. It has high resistance to splitting in nailing and is tough for its weight. In actual tests of boxes, aspen has been found to compare favorably with ponderosa pine in resistance to breakage (6). 1/ In addition, it has light color and lack of odor which are desirable in container wood.

There need be no apprehension about the cutting characteristics of aspen. It is reported to be very similar to basswood in rotary cutting. It can be cut successfully without heating the bolts. Experimental cutting of aspen on a high-speed slicer also has been very successful.

The gluing properties of aspen are excellent. It is classed with those woods "that glue easily with different glues under a wide range of gluing conditions" (7). This makes it well adapted to edge gluing and end joining. Thin panels of veneer or plywood may be readily glued to cleats or framing members.

Aspen is superior to most other veneer woods in paint and enamel holding (5) and is well adapted to surface plies where opaque finishes are required. Its light color and lack of grain allow it to take white and tints with ease. There is no danger of raised grain showing through or of pitch troubles.

The uniformity of grain makes this wood particularly adaptable for plywood uses where uniform wear is required. It wears smoothly without splintering.

Not the least advantage of aspen for veneer is its abundance (8). While old-growth timber, upon which the Lake States veneer industry is based, is rapidly being depleted, aspen is growing faster than it is being cut. It is cheaper than competing woods as raw material. Whether it is cheaper in the finished product depends upon the use of veneering equipment adaptable to small logs and the mechanization of handling small veneer sheets.

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1/ Underlined numbers in parenthesis refer to literature cited at the end of this report.

As usual with second-growth timber, aspen is relatively high in defects. To be successful, use of this species for veneer should embrace both high and low grade uses, such as for container veneer and cabinet veneers.

## PRESENT USE OF ASPEN FOR VENEER

Aspen is used by several cabinet veneer plants in the Lake States when it can be obtained in sizes suitable for their equipment. The volume used is small because large aspen bolts are scarce in the areas where veneer log buyers are active.

Although aspen can be substituted for basswood, mostly for core and crossband veneer, it brings a lower price. A current offer for aspen veneer logs is $65 per M bd.ft. Predominantly a second-growth tree in the Lake States, its logs generally have more knots below a clear surface than do those of old-growth basswood. Undoubtedly if aspen logs over 12 inches in diameter were common, the species would be more widely used by hardwood veneer and plywood plants.

There are a number of plants manufacturing baskets, boxes, and crates from veneer or plywood in the Lake States, but few are equipped to use small logs. Thus aspen veneer is rarely used in these industries. A notable exception is a plant in an area where aspen attains fair size. Specializing in egg crates, this plant prefers aspen for side and bottom slats. A small agricultural crate plant was found slicing narrow crate slats of aspen on a barrel stave machine. A few other occasional uses of aspen veneer for containers have been reported. Although aspen is a good container wood and is used extensively for the lumber parts of veneer containers, it is not widely used as veneer by the container veneer industry. As in the cabinet veneer industry, this is due to lack of equipment to cut small logs.

The only plant in the Lake States using aspen veneer in large volume is engaged in the production of matches. This plant is equipped with special small-log lathes and uses about 7 million bd.ft. log scale per year in aspen bolts to an 8-inch minimum diameter. Besides being able to turn to a 3½-inch core, the lathes are semiautomatic in operation and are adapted to high speed production.

The green bolts are cut without steaming, although in winter they are stored in a room to remove frost. The standard-length bolts are first conveyed to roughing lathes. They drop between the chucks on an automatic centering device. The chucks clamp the bolt, and the bark and irregularities are peeled off. As soon as the bolt is perfectly rounded across the length, the lathe stops and the chucks open automatically, dropping the bolt to a conveyor. At the veneering lathe the bolts roll into an automatic centering device, and turning continues to a 3½-inch core when the lathe stops and the chucks open automatically.

For this particular use, the veneer is cut into narrow sheets by rotary knives attached to the lathe. These sheets are then reduced to square match sticks by a continuous slicing process. The original veneer sheet, however, has the same characteristics as any rotary cut veneer except that the radius of curvature is less than in large-log operations. This results in a somewhat more open "loose face," but the degree of openness is not visually discernible, even at the $3\frac{1}{2}$-inch diameter. For many uses this would have little technical significance.

## METHODS OF CUTTING

### Rotary Cutting

Rotary cutting aspen in volume requires special small-log equipment. Lathes capable of turning to a core diameter of 3 inches should be adaptable to cutting bolts as small as 8 inches in diameter. There is an abundance of bolt material in some Lake States areas which satisfies this diameter limitation. The small lathe alone might not make the veneering of aspen economically feasible, but it should be supplemented with equipment for mechanized handling of bolts and the veneer. Further, a market or use would have to be developed for relatively narrow sheets since the diameter of the core limits the bolt lengths. At small diameters a long bolt does not rotate steadily enough for uniform cutting. As with other second-growth timber, it may be expected that aspen bolts would develop a relatively high percentage of veneer with tight knots near the core. For much of the material it might not be feasible to clip out defects as is done in conventional hardwood veneer manufacture. For an economical operation, markets or uses would be needed for all grades of veneer.

Small-log lathes are common in Scandinavian countries, where wood-using industries are based entirely upon second-growth timber (figure 1). An example of such large-scale use is in the manufacture of hardwood plywood tea chests in Finland for export. It is reported to be common practice in Finland to veneer 6-inch bolts to a core diameter of 3 inches (9). In Sweden, birch bolts of 23 to 25 centimeters (9 to 10 inches) are turned to core diameters of about 5 centimeters (2 inches) (10).

Small-log lathes are used to some extent in the South and the West in this country. The installations are usually small, involving homemade or custom-built lathes, to manufacture veneer agricultural box shook. A common method is to cut the bolts the length of the container slat required. The sheets are then fed into a fixed-interval clipper which makes the slats. Another method of producing shook is to use a "back roll" at the lathe to cut into the surface of the bolt at fixed intervals. The slats are then sorted by grade according to defect.

### Slicing

Slicers for high-speed production have been developed in the West. These are not to be confused with slicers commonly used in Lake States veneer

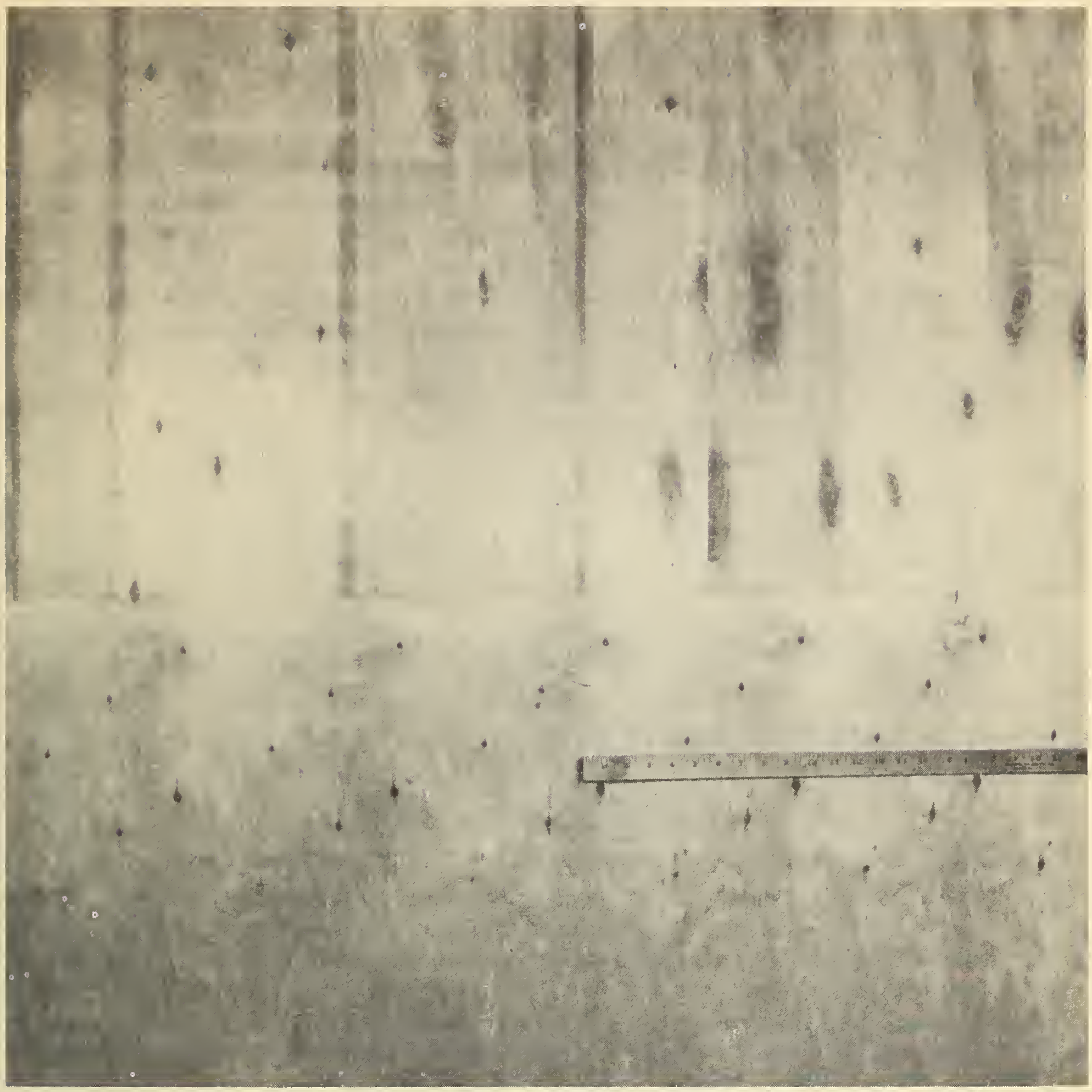

Figure 1.--Sheet of 4' x 4' x 1/8", 3-ply birch plywood made in Finland and retailed in northern Michigan. Note the minimum distance between knots is 8-1/4" indicating a bolt diameter of 2-5/8" at that point. Also note scarf joint, and edge joining of narrow veneer sheets. This size sheet retails currently at 16 cents per square foot.

mills for cutting fancy flitches. They were developed for the production of battery separators and box shook. Sawn blocks are fed continuously into a reciprocating knife, producing slats according to the depth and length of the blocks. One standard model can be supplied with a maximum opening of 36 by 9 inches, although larger sizes could be constructed.

Small logs would limit the size of veneer strip produced, but with careful sawing, blocks could be prepared with less total waste than entailed in sawing lumber. This waste would be minimized if narrow strips could be utilized. Although these machines are now designed for squared blocks, it is possible that a dogging device for round bolts could be devised. This would afford more complete utilization of the bolt and would produce strips of random width which would need to be edged jointed. The slicing method could produce veneer of greater length along the grain than is possible in rotary cutting with a small-chuck lathe. Thicknesses up to 5/16 inch may be cut in the slicing process.

Sliced veneer apparently has more strength as a single sheet than rotary veneer. One western box shook specification allows thinner slats if sliced than if rotary cut. For example, 4-slat orange covers may be supplied in 1/7-inch rotary veneer or 1/8-inch sliced veneer; 2-slat lug covers may be supplied in 1/10-inch rotary veneer or 1/14-inch sliced veneer.

Aspen strips made by this method should be sorted for grade and put to their most profitable use. Some salvage of cull pieces could be accomplished by clipping to shorter lengths and narrower widths. In one western plant this function has been highly mechanized by combining a clipper with multiple trimmer saws (1).

## MANUFACTURING METHODS

The objection that aspen logs produce only small clear cuttings of veneer is less valid today than formerly, since efficient equipment has been developed for building small sheets and strips into larger sheets. As old-growth timber has become scarcer, veneer manufacturers have accepted smaller and more defective logs. This has reduced the average size of veneer cutting and has increased the handling cost for large veneer sheets and plywood panels. Even face veneer is commonly made up of several joined pieces. Equipment for joining veneer strips into sheets with a minimum of manual labor is being evolved to reduce cost of handling the small cuttings. In the conventional hardwood plywood plants of the Lake States a considerable amount of hand labor is devoted to edge gluing veneer into larger sheets. This expense can be borne by high-value furniture and cabinet woods, but is not economical for aspen with its high proportion of small cuttings.

Successful use of aspen for panel stock would require a continuous process whereby narrow strips are fed on a conveyor, glue applied to the edges, and the joined strips passed through a heating element, emerging as a continuous sheet. Such machines are in fairly common use (4, 14). Continuously joined sheets of aspen veneer would be as useful for most purposes as solid sheets of basswood. The strips could be cut on either rotary or slicing equipment. There might be an advantage in favor of slicing, as strips of uniform width are well adapted to mechanized handling and glue application.

For core veneers and for general purpose plywood, glue jointing is not always required, and strips may be formed into sheets by taping with kraft gummed paper (figure 1). A continuous automatic machine for this purpose would need to be developed.

We have mentioned methods for overcoming the deficiency of aspen veneer in width of cutting (across the grain). Rotary veneer from small-log lathes is also limited in length of cutting (along the grain). This deficiency could be overcome by end joining the sheets, as shown in figure 1. A simple scarf joint is the usual method, but the cutting and gluing of the joint is a painstaking and time-consuming operation suitable only for high-value veneers and products. A recent German invention might make it feasible to end-scarf short aspen sheets in a continuous operation (11). An auxiliary knife is attached to the lathe at an angle of 1:20 so that it cuts a scarf edge on the veneer sheet as it is peeled from the bolt. Thus the scarf joints are cut automatically. The scarfed sheets could be formed into a sheet of indefinite length along the grain by passage through a high-frequency gluing machine.

Machines are under development for continuous gluing of laminated boards from small cuttings of lumber of uniform width and thickness. Such a process could well be adapted to small veneer cuttings of aspen. This would be particularly true of strips from a high-speed slicer.

## SUGGESTED USES FOR ASPEN VENEER

Aspen has high technical qualities in the clear wood, yet it has a relatively high percentage of natural defects even in veneer logs. For this reason utilization should be directed to both clear veneer and low-grade veneer in the same operation. A departure should be made from the usual specialization in veneer production where emphasis is placed upon product rather than on the raw material. Container veneer mills often put a significant proportion of high-value clear veneer into a product that does not require it, whereas a cabinet veneer mill may waste a significant proportion of cuttings that are too defective for finish plywood panels but are suitable for containers or utility plywood. Although specialized plants using old-growth timber are able to control the amount of misused raw material by specifying log grades, it is not known whether aspen logs can be graded effectively for this purpose.

## Container Veneer and Plywood

The container field should offer an excellent outlet for aspen veneer. Aspen has properties found in many preferred container woods. For some types of containers its low density might have to be compensated by slightly greater thickness to attain strength equal to competing woods. The production of aspen box slats by the high-speed slicing process should compete successfully in the Lake States with resawn high-cost western lumber.

The toughness and resistance to splitting of aspen should suit it for stitching veneer slats to cleats for container shook. The wirebound box has a wide and growing application in the packaging field, and aspen veneer strips should be suitable for this highly mechanized construction. Cottonwood, a close relative of aspen and quite similar in properties, is in common use as wirebound box slat material. Experimental wirebound boxes made with aspen slats have shown up favorably.

Aspen veneer even in comparatively narrow and short sheets should be well suited for plywood containers of popular size. For many types of plywood container panel, restrictions on defects would not be difficult to meet, and the core and back ply could utilize sound defects. As in other plywood uses, it would be most economical to mechanize the production of large veneer sheets from relatively small strips.

## General Purpose Plywood

General purpose plywood might be defined as that where neither the density and finishing characteristics of birch nor the structural strength of Douglas fir is required (figure 1). There are literally hundreds of factory and retail uses for which aspen should be adequate, such as for signs, boatfittings, household cabinets, unpainted casegoods, concrete forms, display fixtures, trailer and bus fittings, ironing boards, lockers, store fixtures, furniture back panels, and luggage. Its moisture stability, smooth texture, and excellent paint and enamel acceptance make it equal or superior to many competing woods. The growing practice of overlaying common grades of plywood with plastic, resin-impregnated paper, or metal sheets (2, 3) would overcome common defects and frequency of veneer joints of aspen plywood.

The western softwoods are firmly established in the general-use market, but that market is still expanding and the freight advantage to large consuming centers seems to offer Lake States aspen an excellent opportunity to compete. Success will depend upon cutting costs of production through mechanization to outweigh the production cost of plywood from large clear veneer sheets from western timber. At present aspen is unknown in the general plywood market and also suffers from an unjustified prejudice. Its introduction into the plywood market will require considerable sales effort, but it should find a place in the market as an adequate but cheaper substitute for the more commonly used plywood species.

## Special Use Plywood

Special use aspen plywood should do well in lumber panels where low density hardwoods of uniform structure are required. This is the field in which basswood has long been known as a special use wood. The key uses in this category are drawing boards, bread boxes, paper hangers' boards, and plywood cores. There are numerous manufactured articles for which well manufactured panels of aspen plywood are technically superior to high-density hardwoods or to the characteristically non-uniform-textured softwoods. Clear-faced aspen plywood would be more acceptable than aspen lumber, since high grades of aspen lumber are too uncommon to be widely used for factory purposes. Basswood has long enjoyed a preference as lumber core stock upon which to glue high-quality face veneers. Recently aspen cores have become recognized as having similar desirable properties for this use. Aspen plywood panels should also be well suited for overlaying with fancy face veneers. Crossbanding between surface plies and cores could as well be of aspen as of basswood.

The properties that should be stressed in proposing aspen for special uses are (1) ease of gluing, (2) excellent acceptance and retention of paints and enamels, and (3) smoothness in wearing without splinters. These are characteristics which aspen possesses in common with such commercially favored woods as basswood, white pine, and yellow poplar.

## IMPROVED WOODS

Improved woods such as "Impreg" and "Compreg," developed by the Forest Products Laboratory, are most readily processed in the form of veneer, since complete impregnation of solid wood is difficult. The veneer sheets are treated with the appropriate chemical and then combined to form blocks of required thickness. Aspen because of its low density absorbs chemicals more quickly and to a greater degree than denser woods.

The several processes for increasing the moisture stability and hardness of wood by impregnating with resins or resin-forming chemicals are slow in coming into commercial use, mainly because of the high cost of treatment and of the chemicals. So far the method is reserved for articles of high technical requirements and high cost. As methods of production are cheapened and as chemical costs are reduced, these processes should become more widely adopted. An opportunity exists to establish carefully manufactured and graded aspen veneer as a favored raw material for modifying treatments.

One of the advantages of "Compreg" is that it "can be made from soft, inferior species that normally are not used for furniture and a product obtained equal in appearance and in almost all strength properties to "Compreg" made from birch or maple" (12). Aspen actually has some advantages over denser woods in this process. It may be removed from the press hot, thus avoiding a costly cooling period in the press (13).

## LITERATURE CITED


(1) Anonymous
1947. Retrieving waste veneer. The Timberman. 48(3): 154, 156.

(2) ______
1948. Paper and plastic overlays. The Timberman 49(3): 65.

(3) ______
1948. Production of "Welchboard." The Timberman 49(3): 68,70, 74, 76.

(4) Arneson, Gus H.
1947. Possible uses of radio frequency heating in the plywood industry. University of Washington, College of Forestry, Bulletin No. 2. pp. 21-23.

(5) Browne, F. L.
1934. Behavior of house paints on different woods. Forest Products Laboratory Report No. R 1053. 19 pp. (mimeo.)

(6) Carlson, T. A.
1929. Suitability of little-used species for containers. Forest Products Laboratory Report No. R 1402. 9 pp. (mimeo.)

(7) Forest Products Laboratory
1940. Wood handbook. U. S. Department of Agriculture Unnumbered Publication. 325 pp.

(8) Lake States Forest Experiment Station
1946. Revised forest statistics for the Lake States, 1945. Station Paper No. 1, Lake States Forest Experiment Station.

(9) Leicester, W. F.
1944. The influence of modern glues on the utilization of wood. Conference Report on New Developments in Wood Products, New York State College of Forestry. pp. 53-63.

(10) McKellar, A. D.
1947. Veneer and plywood industry in Sweden. Industrial Reference Service. Part 6, Forest Products, Vol.5-Part 6, No. 5, pp. 1-4.

(11) Seborg, R. M. and Fleischer, H. O.
1945. Veneer and plywood manufacturing techniques and machinery observed in Western Germany. FIAT Final Report No. 389, Joint Intelligence Objectives Agency.

(12) Stamm, A. J.
1944. Possible use of improved woods and wood-based plastics in the furniture industry. Forest Products Laboratory Report No. R 1482. 4 pp.

(13) ______ and Seborg, R. M.
1941. Resin-treated, laminated compressed wood. Forest Products Laboratory Report No. R 1268. 8 pp.

(14) Wood, A. D. and Linn, T. S.
1943. Plywoods, Chemical Publishing Company. 363 pp.